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PSYCHOLOGY

BY

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COLUMBIA UNIVERSITY

New York

THE COLUMBIA UNIVERSITY PRESS

1908



² PSYCHOLOGY;

A LECTURE DELIVERED AT COLUMBIA UNIVERSITY
IN THE SERIES ON SCIENCE, PHILOSOPHY AND ART
MARCH 11, 1908,

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Set up, and published April, 1908.

PSYCHOLOGY

IN attempting to give a view of the present state of his science—a view that shall be fairly objective and free from the bias of his own particular interests—the psychologist encounters a peculiar difficulty in that the camp of his fellows is divided. Two standards are displayed; two parties are in the field; and their relations are not always so friendly as might be expected of soldiers in a common cause. Such divisions are indeed not unknown in the other sciences. The descriptive and the dynamic phases of a subject, the study of structure and the study of function, frequently divide the workers between them, and sometimes those who hold to the one despise the other. The line of cleavage is sharper in psychology than elsewhere: those who define psychology as the science of consciousness—the “morphology of consciousness,” as one has put it—maintain that any study which does not contribute to the description of conscious life lies beyond the pale of the science; whereas to those who define it as the science of those functions of the organism which are roughly designated as *mental*, the examination of the consciousness attending these functions, though valuable and suggestive, does not lie at the root of the matter. This strife is indeed carried on more at the level of theoretical discussion than at that of practical investigation, for those who work at special problems are apt to approach them from both sides.

There are then two general problems of psychology, and

two general methods, one appropriate to each problem. Consciousness affords a rich variety of phenomena, which tempt the scientifically inclined observer to describe and classify them. Even as the variety of plants, with their gradations of likeness and difference, led the naturalist to descriptive and systematic botany, so the multitude of sensations and emotions, of memories and fancies, thoughts, desires and decisions was sure, in time, to entice those who were gifted both with scientific curiosity and with a self-observant temper into an effort at setting down these multifarious appearances in some kind of order. The method appropriate to such studies was imposed by the nature of the case. As we can not enter directly into the consciousness of our fellows, each observer must examine his own, by introspection. And not all self-observation is entitled to be called introspection. Since a thing can be observed only when it is present, the observer of conscious facts must have those facts within him at the moment of observation. He must serve simultaneously as the observer and as the generator of the thing observed. This creates a difficulty for the introspectionist which is practically very great, and theoretically insurmountable. Comte went so far as to assert that it made psychology impossible. The subject and the object of an observation can not be the same, he said. I can not divide myself into two persons or agents, one of whom does something which the other notes. And without such a division, self-observation is impossible, for if I do anything, I am occupied with doing it and not with observing it, whereas if I set myself to observe, there is nothing doing to be observed.

The antinomy of the introspective method is however not quite so sharp in practise as the philosopher has asserted. If it were, you could not even state with confidence that the speaker's voice was audible to you. And much more than this is possible. You can be sure whether the word

“antinomy” gave rise in you, a moment ago, to a prompt feeling of recognition, or to some hesitancy and disaffection towards the speaker. That introspection is to some degree possible arises from the fact that the consciousness of a moment is not an indivisible unit, but has parts. More than one process may simultaneously go on in it, and one of the simultaneous processes may consist in observation. Some persons frequently have the feeling of a division within them, one part being engaged in watching what the other is doing.

But the difficulty of introspection is only half overcome by this doubleness of consciousness, for the processes that go on simultaneously are not without influence on each other; they often interfere with each other’s completeness and efficiency. If the process to be observed is easy and the observation also easy, little confusion need result; but when the process to be observed is complex or absorbing, as in the case of an emotion or difficult task, it becomes hard to maintain the attitude of the scientific observer; and in so far as the observer’s attitude is maintained, it is doubtful whether the other process runs its normal course. Thus the introspective psychology of the emotions is more properly the psychology of the emotions while psychologizing.

Some help comes to us here from the existence of a “primary memory,” from the readiness with which an experience can be recalled before it has fairly passed out of consciousness. Just as the words of a speaker linger for a while, and may, as it were, be forcibly haled back before they are fully gone, to receive more careful attention than they got at first, so even a poignant emotion may suggest, as it starts to fade away, that here is the opportunity, so long desired, of making an interesting observation. Such a suggestion would hardly occur to anyone but a psychologist, and not to him as often as might be desired.

In spite of these mitigating circumstances—the possi-

bility of two simultaneous processes in consciousness and of primary memory—the case of introspection is a hard one, and many, even psychologists, are disposed to regard its results as seldom reaching the standard of scientifically observed facts.

When, in the middle of the last century, a few psychologists believed the time had come for the introduction of experiment, they did not aim to substitute a new method for that of introspection, but to provide conditions under which introspection could be more precise. One improvement consisted simply in making it first hand, in substituting definite observations for vague impressions derived from past experience. The older psychology—distinctly an armchair science—had been in reality less introspective than retrospective. The net result of past experience had been relied on, and no need had been felt for going back to the individual instances. Single observations, recorded on the spot, form the basis of modern psychology. We no longer accept a general conclusion unless we are shown the individual recorded instances on which it rests.

Along with recorded observations go repeated observations. The variability of conscious events is so great that it is never safe to depend on single instances. For a similar reason, it is now felt to be unsafe to rely on the introspection of a single observer. In the earlier days, which now seem to us days of happy, easy confidence, when the psychologist had made an observation on himself, he said, not “I do so and so,” but “We do so and so,” never doubting that other minds would do the same as his. Such confidence is now known to be misplaced. The varying self-observations of many minds must be collated, and their agreements, if any, separated out from the mass of disagreement, before arriving at a description which shall have a claim to universal validity.

These reforms have made introspection more conscientious.

tious, and necessity has also made it more modest. It can not hope to grasp the whole of a conscious event in a single observation. The attention of the observer must be focused on some definite and often minute point. He must not attempt to describe his experience in full, but to answer the simple question, "Do you observe this—yes or no?" Such observations are minute, microscopic almost, and attempts are made to make them genuinely microscopic in some such way as the following. Besides the observer, in whom the conscious process is to be aroused, a second person is present as the conductor of the experiment, a sort of stage manager. He prepares the apparatus and other externals, and sets the observer some task, such as the comparison of two physical stimuli as to their intensity, duration, pleasureableness; or it may be some intellectual problem is to be solved. But, instead of letting the observer alone till the task is finished, he interrupts him in its midst, and questions him regarding the consciousness present at that stage. Now ordinarily, with the naked eye of introspection, we attend so little to the way we feel while performing a mental task, to the consciousness which intervenes between the grasping of the question and the appearance of the answer, that we could give little account of it. By the intervention of the manager of the experiment, it becomes possible to catch some of the fleeting consciousness ere it disappears and so to reveal details which would otherwise remain hidden.

By such devices, introspection can be made to give data of sufficient precision for scientific use; but the data are of a minute and technical sort, and fail to satisfy the natural curiosity of man as to the deeper and higher things in experience—the absorbing emotions or the flights of imagination. In short the complaint is made that experimental psychology is lacking in human interest; and should not psychology, of all subjects, possess human interest? The

psychologist too would wish to rise to these noble themes, but he feels that he could not as yet deal properly with them. He is comforted by the thought that the exceptional may really be less important than the ordinary run of experience, for the purposes of a science of consciousness. As history shows a tendency to descend from the heroic to the routine in the experience of the race, believing that only thus can the past be truly revealed, so psychology, driven largely by the necessities of its method, has already made a similar descent. It might well be expected, therefore, that an inventory of the results of introspective psychology would be rather a dry and technical affair, unsuited to the present occasion. Let me try, however, to set forth a few results which may have some interest. A definition is first necessary. A "moment" in psychology—not necessarily a "psychological moment"—is so much of consciousness as seems to be simultaneously present; the present moment of consciousness is so much experience as is being got now—just now. Formerly, under the influence of physical analogies and of the dogma of the unity and simplicity of the mind, the moment was conceived as a point, a moving point to be sure, and a point that changed in quality as it moved, but a point in time, leaving its past instantly behind it, and a point in breadth, admitting of no simultaneous plurality. Introspection, under experimental control, reveals no such mathematically perfect atom of consciousness. The moment is extended in at least two dimensions. It is extended in time. Absurd as it may seem to speak of the present moment as reaching back a little way into the past and even forward a little into the future, this must not deter us from describing consciousness as we find it. So described, the present moment, though it has a center corresponding somewhat with the mathematical present, contains also a dying away of events that have just passed the center, and

a coming in of events that have not yet reached the center. The shadows which coming events cast before them in consciousness are partly of the nature of expectancies, and partly due to the imperfect perception of events which have already happened but are only beginning to take hold of us. We live a fraction of a second, or more, behind the time, and can never catch up, because time is always needed for a new event to win the center of consciousness from the old event that holds it. The center of the felt present, the thing which most occupies the field, is always a little behind the newest thing in consciousness. Nor does the old event, which gives way to the new, drop instantly out of sight; it lingers, gradually dying away; it remains as something which is passing but is not yet wholly past.

That the conscious moment has another dimension besides its length in time is also clear to introspection. A plurality of items may coexist within it; the contrary doctrine was not founded on empirical observation.

Yet the moment is not a bare sum of discrete items. It shows internal organization. The items are related to each other; they tend to be grouped into wholes. A series of sounds, physically of equal intensity and with equal intervals between them, is not heard as such. Some of the sounds receive a subjective accent, and some of the intervals are subjectively lengthened, with the result that the series seems to have a rhythmic form. So, a jumble of dots on a plain background are seen as if grouped. The grouping may change on continued examination; but, at any one moment, the dots are organized in a certain form. However disconnected the items presented at a moment may be as physical facts, they are almost sure to appear in consciousness as fused, contrasted, grouped or in some way related to each other.

The moment is centered about some item which is tem-

porarily the most prominent; it occupies, as we say, the focus of attention, while other items lie more to the margin of inattention. If one's mind is centered on a speaker's thought, then the peculiarities of his voice or appearance, the appearance of others near him or in more distant parts of the room, extraneous noises, and one's own bodily feelings, may still be marginally present in one's consciousness; though unimportant intellectually, the blend of these obscure components of consciousness has its significance as constituting the emotional undercurrent of the moment.

One moment shades off into another; no exact boundaries appear between them. Their sequence is not like a succession of separate views, but each dissolves into the next. Professor James, in a chapter which is among the most successful efforts at introspective description, discards the old metaphors of a chain or train of ideas as entirely inadequate, and substitutes the figure of a "stream of thought." He also calls attention to the existence of conscious transitions or modulations from one prominent idea to the next, the transitions consisting in a variety of feelings of expectancy and relationship. From all this it will be seen that present conceptions of conscious process differ widely from the cut-and-dried schemes which were current a generation or less ago.

An important result, along quite a different line, came out of Galton's inquiry into the mental imagery of various persons. When he asked them to think of some familiar scene, some reported that a picture of the scene arose within them, and appeared before the mind's eye almost as if present to sense. Others had much less of this pictorial consciousness; still others reported an entire absence of any such thing. Though they recalled the scene to mind, and were prepared to describe it, they did not picture it to the inner sense. The same individual differences appear in the process of recalling auditory,

olfactory and tactile experience. It is the existence of great individual differences in the consciousness of the same facts which gives interest to this result. Men may compare notes regarding what they have experienced, and agree as to the material facts, while nevertheless their modes of being conscious of the recalled facts are extremely diverse.

A number of recent studies of the consciousness attending important mental functions, such as judgment, reasoning and voluntary action, have come to negative conclusions which yet have their value from one point of view. There appears to be no definite sort of consciousness appropriate to each of these functions, no introspective mark or differentia of each. Given the starting point of a mental performance and its outcome, we can not infer what consciousness intervened. This is true even of the simple case, familiar in the laboratory, in which two sense stimuli, one following the other, are to be compared in intensity. The old conception of the process was that when the second stimulus came, an image of the first recurred to mind; the two were held up side by side in consciousness and their likeness or difference read off. Experiment shows, however, that though this is sometimes true, more often the judgment of likeness or difference arises immediately on the presentation of the second stimulus, without any renewed consciousness of the first. Such results show that conscious process is more fluid and less diagrammatic than is assumed by those who work out logical schemes of what it must be. They show too that consciousness can not be known by its fruits. You can not infer what consciousness must be from its objective manifestations, nor even can you, keeping wholly within the stream of conscious events, infer what has gone before from what follows. Each bit of consciousness must be known, if at all, by direct observation.

Facts like these make it seem impossible to employ an objective method in psychology. Many students of the subject, in short one of the two great parties into which psychologists are divided, repelled by the difficulties and the treacherousness of introspection, have resorted to the examination of objective facts connected more or less directly with mental life. Some have gone so far as to assert that only by such means could scientific information regarding the mind be reached. As examples of such studies may be mentioned folk psychology, which examines language, myth and literature, art, customs and institutions, with the object of inferring back from the products of mental activity to the character of the activity. We have also animal and child psychology, which endeavor to deal with minds incapable of reporting introspective observations. Here belongs as well a large part of the work done in experimental psychology, for often the person experimented on does not serve strictly as an observer of his inner consciousness, but has simply to react in some assigned way to a situation which is presented to him. He may have simply to move his finger as quickly as he sees a certain light, or to move his right forefinger when red is shown him and his left forefinger when green is shown him, or he may have to name a presented object as promptly as possible, or answer a given word by another word standing in some assigned relation to it. He is not asked to observe his consciousness during the process, but simply to react. In another line of experiment, the person examined is presented with two weights differing but slightly, and is asked to say which is the heavier. He is not asked to describe the contents of his consciousness during his process of judging, but simply to judge. Or again, in an experiment on memory, he is given a list of disconnected words or syllables, which he studies till he can repeat them in proper order; a day later he is tested to

see how much of the list he retains. He is not asked to describe his subjective experiences while learning or recalling these words, but is merely required to learn and recall them.

Many similar experiments have been carried on in psychological laboratories, and have been received by the introspectionists with no great applause. They denounce the method as unpsychological. "You are not attaining to a description of consciousness by this means," they say; and, in the light of the facts alluded to a few moments ago, they are clearly right. From the examination of a painting, for example, you can not tell what was in the mind of the painter when he conceived his work; it might seem that he must have had before him a mental picture of which the existing painting is a copy; but among the painters who have been asked regarding this, some have denied that such a mental image was present, and even that they had the power of forming a mental image. When we already know a form of consciousness, its objective manifestations, and the regularity of the connection between them, we can of course infer with some degree of probability from the manifestation back to the condition of consciousness. But we must first know consciousness.

From all this it becomes clear why the introspective psychologist accuses the objective psychologist of sailing under false colors. He may be studying something, and doubtless is, since he gets results which display considerable regularity and precision, but he is not studying consciousness, and if psychology is the science of consciousness, he is no psychologist. The introspective psychologist dubs him a "psycho-physicist," or a "gnoseologist," or a sort of physiologist; and mollified by the verbal distinction, goes his way, leaving the objective student to go his. The choice of words need not detain us here. The thing to notice is that a large share of those who call themselves

psychologists are concerned with the facts which can be found by the objective method. Of what nature, then, are these facts? The objective wing has not taken much trouble to justify its position formally; but I think it fair to say, after an examination of the detailed problems which they set themselves, that they are looking for the facts of mental function, that they are seeking the causes and conditions of mental performances, in short that their study is dynamic. They are not trying to describe consciousness, but to unearth the causal relations which obtain among mental performances and between them and their physical conditions and manifestations.

It should be noted that the introspective method has not much to tell of the causal relations of the conscious events which it studies. For one thing, consciousness is not a closed system. Physical stimuli are always breaking into it from outside, and its own processes are constantly leaking away through motor channels. The dynamics of consciousness could no more be discovered by confining attention to consciousness itself than the laws of plant growth could be made out by studying the plant in isolation from the soil, air and sunlight. But, what is rather surprising, consciousness not only fails to reveal the external factors which determine the course of thought, it does not even reveal with any completeness the internal or cerebral conditions of thought, as the following simple experiment illustrates.

Set yourself to add pairs of numbers—the one-place numbers will do as well as any. As each pair is presented, the sum immediately occurs to mind. But now change the problem: set yourself to multiply pairs of numbers; then the appearance of a pair straightway calls up the product. In one case you are ‘set’ or adjusted for addition, and turn out sums; in the other you are set or adjusted for multiplication, and turn out products. Since the numbers

given may be the same in the two cases, and yet lead to different results, it is clear that the mental adjustment has much to do with your reaching the right answers so promptly. But now interrupt yourself in the midst of such a series of operations, and ask what consciousness you have of this set or adjustment which is causally so important. Usually you will find nothing—nothing, at least, more definite than a feeling of readiness for what is coming—nothing characteristic of the exact problem which you are prepared to solve. And, on the other hand, you may find many things which probably have nothing to do with the mental performance in question—sensations, images and tinges of emotion which only happen to be there at the same time. It is clear that conscious process does not correspond closely with mental process, if by the latter term is meant the process that leads to some mental result—a perception, a recollection, an invention, a preference, a decision, the solution of a problem. He who would trace the dynamic process by which such results are reached can not content himself with the introspective method, though it may indeed give him valuable suggestions.

It is this sort of task which is taken up by those psychologists who use the objective method. The essence of the method consists in arousing a certain type of reaction to a given situation, the conditions being standardized, and the reaction, as far as possible, reduced to quantitative terms. The conditions are now varied in accordance with some definite plan, and the corresponding changes in the reaction are noted. The relation of the changes in response to the changes in the conditions is the important thing. For example, it is desired to discover how the sense of sight, which at first thought seems incapable of giving anything more than two-dimensional pictures, such as might be accurately represented in a colored photograph, nevertheless enables us to judge of the third dimen-

sion, of the distance of objects from us. Introspection does not reveal the factors which determine the judgment. Several possible factors are suggested, as hypotheses are suggested in any science; such as perspective, haze, the presence of intervening objects, and the slightly differing views of the same object which are had by the two eyes. To investigate the importance of intervening objects as a factor in determining the judgment, we remove them, placing the person examined in a dark room with only one spot of light visible, the distance of which he has to judge. We find that he does so very badly; we then restore some of the intervening objects and, finding his judgment improved, we conclude that the presence of intervening objects is a factor in the judgment of distance. Similarly, to examine the importance of binocular vision, we compare the accuracy of the judgment with one and with both eyes; and finding it superior with both,—finding also that the stereoscope, which presents to the two eyes slightly different views corresponding to what each would see in looking at the object, gives a strong impression of solidity and distance,—we infer that the judgment of distance is based largely on this difference between the two fields of view.

It is the task of the dynamic psychologist to devise means by which to control the conditions under which a mental operation is performed and by which to gauge the character and success of the operation. For controlling the conditions a great number of special devices are employed, which can not easily be summarized in a few words. For gauging the success of the operation, measurement can be applied in three ways at least, as to its speed, its accuracy and what may perhaps be called its force or energy. As examples of the measurement of the energy of mental activity may be mentioned the determination of the number of items of a given kind that can

be grasped at a single glance—the number being found to increase greatly when the items are related in easily perceived ways—or of the amount that can be memorized at a single reading. More common are measurements of speed and accuracy. The older classics of experimental psychology are largely devoted to the accuracy of sense discrimination and to the speed of simple mental processes. The speed is valuable as affording an index of the complexity and difficulty of the mental operation.

In recent years, the center of gravity of investigation has shifted from perception to the motor processes and especially to the central processes, such as association, memory and the effects of practise or training. Eye movements, important to psychology because of their connection with theories of space perception and of appreciation of beauty of form, and with the act of reading, have been recorded photographically by psychologists, with rather striking and important results. Many facts are being disclosed regarding the conditions of greatest efficiency in memorizing, and regarding the laws of retention and recall. In the older work, the improvement of a function with practise was principally a disturbing factor, since it created difficulty in the way of comparing repeated observations on the same person. Of late, the practise effect has aroused interest for its own sake. The person tested repeats the same performance time after time under the same conditions, his success being measured. Almost any performance will serve as the subject matter of the experiment, since all improve with practise, though in unequal measure.

The results may be presented graphically in a “practise curve,” which, much after the fashion of the temperature curve of physicians or the curves of barometric pressure and wind velocity put out by the weather bureau, shows the changes in efficiency of the function with the progress

of training. Much might be said of the results of this line of study. If we analyze the lack of precision of a performance into its variability, by virtue of which the successive repetitions differ irregularly among themselves, and its constant error, by virtue of which all the repetitions differ in the same direction from the truly successful performance, then it appears that repetition will by itself reduce the variability, but will not eliminate the constant error, which can only be trained out by checking up the performance against the standard of success. Only repetition gives regularity; only correction conduces to perfection. When the standard of success is not very high, corrected practise leads to speedy perfection. When the operation is difficult or the standard of success high, as in telegraphy, the improvement, at first rapid, becomes discouragingly slow, but after several months of continued practise, may take a sudden rise, leading to a condition of passable proficiency, after which further gain is slower and slower, as the "physiological limit" of the individual for that performance is reached. But experiment has also shown that the physiological limit is seldom reached, or closely approached, in the usual, non-experimental conditions of the practise of a trade or profession. Type-setters, after ten to twenty years of experience, were thought by a certain investigator to be suitable subjects for an experiment in which it was desirable that the subjects should have reached their utmost efficiency. When the experiment was begun, an immediate rise was noted—which by itself was not surprising. What was surprising was that after this sudden jump, due to the increased stimulus of the test, there came a gradual rise, a practise curve, in fact, on top of ten to twenty years of practise. Similar results have appeared in other lines of work. Under the condition of a practise experiment, a German-English vocabulary can be learned with considerably greater speed—and

apparently also retained better—than in the ordinary conditions of school or private learning. The stimulating influence of the experimental conditions lies in part in the fact that the individual has a measure of his success, and in part in the competitive stimulus; he competes not only with others—a sort of competition which is usually unequal—but also with himself. Herein appears a contrast between introspective and dynamic studies: whereas the conditions of an introspective observation interfere to some degree with the process which is observed, an experiment in dynamic psychology is apt to arouse the function exercised to its full activity. The practical value of these results both to the educator and to any man in the conduct of his life and business is obvious. If one's work can be made an experiment, and the success of it measured and recorded, a great gain in efficiency may be expected.

Much of the newer and more exact work in one of the most flourishing departments of psychology, that which examines the mental capacities of various orders of animals, depends for its method on the study of the practise effect. The questions whether an animal can learn, how fast, how much, and by what means, are fundamental. Considerable revision in our conceptions has been brought about lately by the discovery that even protozoans can be taught, that their behavior is modifiable by experience. At the other end of the scale, tests show that the primates are nearest to man, not only in anatomy, but as well in fertility and quickness of learning, while still the highest forms which have so far been carefully studied are inferior to the human infant of the age of one year. The anthropoid apes have not as yet received the attention they deserve. The method has been employed in endeavoring to answer the vexed question regarding the reason of animals. Most of the discussion of this topic rested, till quite recently, on anecdotes rather than on experiment. The defect of the

anecdotal method is that, though the animal is known to have learned, no observations have been made as to how he learned. It may be asserted that no movement whatever, however skilled and however adaptive, can prove reason in its performer, in the absence of knowledge as to how the movement was acquired. The most wonderfully skilled and adaptive of all movements are inherited, not acquired, by the individual. The practise-curve method gives at least negative information in the following way: Whatever may be the full definition of reason, it is clear that in practical use it involves grasping the essential feature of the situation—essential, that is, for the purpose in hand—and reacting to this feature in neglect of the unessential. Place a human being in a cage from which he can escape by some concealed mechanism, and his first efforts will of necessity be blind experimenting, resulting finally in accidental success. Replace him in the cage, and in the course of a number of trials he will observe by what means his success comes, and will from that instant drop all his unsuccessful gropings and do only the one thing needful. No such moment of insight is revealed in the process by which a dog or cat learns most of his tricks, and in the case of the monkey, though the process of learning is rapid when the trick is simple enough, there is in more difficult cases no sign of a moment of comprehension. The difference may however be a matter of degree—of the degree of complexity which the different species are capable of grasping. When the thing to be learned is so simple as the mere location of an object that causes pain, it can be learned by a mouse in one or two trials. Harder tasks, such as pulling a string, which a cat learns only by a long and gradual process, are learned in a few trials by a monkey. A still more difficult performance, as, for example, the opening of a door by a combination of simple acts which must be done in a certain order, can hardly

if at all be taught to a cat, and to a monkey only by a slow process like that seen in the cat in learning the pulling of a string, while an adult man learns it in from two to six trials. But there are tasks yet more complicated and recondite, which even man learns only by the slow and gradual process—a process in which the essentials of success are never recognized, though success is finally attained by the gradual and unnoticed elimination of false moves. Examples of this process in man are seen in the acquisition of high skill in singing or playing the violin, or in handling the sword or tennis racquet. Insight is not entirely absent here, but insight alone does not do the work, as is seen from the fact that perfect form results only from the slow accretions of constant practise.

Besides animal psychology, the most cultivated among what may be called the outlying fields of psychology are the genetic and the pathological. Progress is being made in tracing the rate of growth of the capacities of the individual, in correlating mental with physical growth, and in assigning to hereditary endowment on the one hand and to experience and training on the other their contributions to the superiority or inferiority of the individual to his fellows—the preponderance certainly seeming to lie on the side of heredity. In mental pathology, a vast amount of preliminary prospecting has been done by physicians, and the ground prepared for more rigorous observation and experiment, which has indeed been begun, particularly with neurotic patients, hysterical neurasthenic and epileptic.

Abnormal psychology is in large measure an application of the science for the practical ends of diagnosis, of suggesting modes of treatment and of testing their success. It is hoped, not only that the results of psychology may help towards the understanding of mental abnormalities, but that the methods of psychology may prove capable of

adaptation to the needs of those who require quantitative tests of mental condition.

The principal application of psychology is, at present, to education. Such work as that above mentioned on practise and learning has an obvious bearing on the problems of the schoolroom, while some of the broader results of genetic psychology are germane to the task of those who arrange the courses of study. But, as with the applications to medicine, it is not simply the results of psychology that should prove fruitful in education; it is still more to be hoped that the empirical and experimental method may spread over from the one to the other. Education must become a science on its own account—an experimental science—related to psychology somewhat as engineering is related to physics, or agriculture to botany. With so much experience as he gets of the great differences in result that sometimes follow from slight changes in the conditions, the psychologist would be the first to admit that the conclusions reached in his laboratory ought not to be carried over without discrimination into the schoolroom. The problems of education must finally be solved by experimentation within the educational field.

With much the same reserve the psychologist approaches the possibility of applying his science to other fields, such as business—in which, for example, the conditions of successful advertising form clearly a psychological problem—and such as the practise of law. The courtroom teems with problems which are not simply psychological in the vague sense that they are concerned with mental processes, but are such as can be attacked by methods that have been worked out in psychology. The reliability of testimony, the influence of leading questions on the reliability of the answers, the relative merits of judge and jury as devices for establishing questions of fact, are fit subjects for an experiment, the main point of which

would be to insure that the facts regarding which the testimony is to be given be certainly known in advance to the experimenter. Some work has already been done by psychologists in collaboration with professors of law on the reliability of the testimony of eye-witnesses; and rather a surprising degree of unreliability has been disclosed. Not only is there a large percentage of omissions, but there is a smaller but still considerable percentage of positive assertions of what did not take place. It is almost impossible for anyone to witness an event without forming to himself some conception of its inner meaning and reading this meaning into the event as he sees and as he remembers it; and as a false meaning may very readily be read into events, the testimony will be correspondingly vitiated. Such general criticism as is implied in this result is perhaps of no great practical value; and in fact the legal profession has not received this incipient irruption of psychology into law with any great show of enthusiasm. But when the experiment is carried into details, and the varying reliability of testimony to different classes of facts and by different classes of persons is assigned—when, for example, it is found that the time occupied by an event is judged very poorly, that inherently probable and commonplace events are less reliably reported than inherently improbable, or that the reliability of a person's testimony bears no very close relation to the confidence with which he gives it—it would seem that the results were capable of application. Here again, however, the conclusions obtained in the laboratory need to be retested in the sphere where they are applied.

It is the hope of psychology that her results may prove capable of application in the work of her sister sciences, especially zoology, anthropology, sociology and every science that has to do with human or animal behavior. She comes in contact with still other sciences, especially with

physics, from which she derives much of her technical equipment; with mathematics, from which she derives the statistical methods that are necessary in much of her work; and even with astronomy, which gave the impetus to one of her earliest problems, that of reaction time and the personal equation. But it is to philosophy and physiology that the relations of psychology are particularly interesting. Psychology has sprung from each of them, though not exactly from their union. Both philosophy and medicine have been called mothers of the sciences, and psychology filially owns the relationship in each case. The philosophical parentage is of long standing, the medical or physiological—for in this instance it is fair to identify the two—dates from the last century. In spite of these historical dependences, psychology has the right to an independent standing as a science. The close relation of philosophical and psychological interests can easily be over-emphasized. Philosophy is not specially dependent on psychology; it needs the data of psychology, but it needs equally the data of the other sciences. Nor is the dependence of psychology on philosophy peculiarly close. Every science has its metaphysics, its presuppositions and ultimate questions the proof or solution of which is not approached by the methods appropriate to that science. The fact that students of psychology seem particularly prone to become worried over such questions is probably to be explained by the historical association of the two sciences, and is a tendency rather to be deprecated than encouraged. In the actual, immediate, concrete work of his science, the psychologist is no more concerned with metaphysical questions than is the chemist or the zoologist.

The relation of psychology to physiology is of a different kind. Physiology is not only occupied with applying physics and chemistry to the living organism—which is no doubt its main business—but also, finding certain organs

the function of which can not as yet be stated in physical and chemical terms, namely, the sense organs and the brain, and yet wishing, for the sake of completeness, to state the functions of these organs as well as may be, it has had recourse to methods which do not differ appreciably from those of psychology, depending as they do on the reactions and self-observation of the conscious subject. Thus the provinces of the two sciences overlap to quite an extent; and there are those who will have it that psychology, in so far as it amounts to anything, is but a part of physiology. The practical answer to this is that physiologists will not usually investigate such things as the peculiarities of memory and imagination. Were it not for the psychologist, the problems of mental action would remain unstudied. He comes in to fill the gap left by physiology because of the high development of its physical and chemical technique and the engrossing success which that technique is meeting.

But is this gap more than temporary? If the goal of the physiologist were attained, and all organic functions were dissected and accurately stated in physical and chemical terms, would there be anything left for the psychologist to say? Would not his cruder statements become obsolete, as the vague outlines of a landscape seen in the morning twilight lose their significance in the full, clear view of day?

Socrates, one of the founders of psychology, as he sat in prison with his disciples, waiting for the jailer to bring him the fatal draught of hemlock, alluded to the difference between the physiological and the psychological points of view in some such terms as these: "What should we think of a person who, when he endeavored to explain the causes of my actions, should proceed to explain that I sit here because my body is made up of bones and muscles: . . . and as the bones are lifted at their joints by the contrac-

tion or relaxation of the muscles, I am able to bend my limbs, and that is why I am sitting here in a curved posture; . . . and should give a similar explanation of my talking with you, which he would attribute to sound, and air, and hearing, and ten thousand other causes of the same sort; forgetting to mention the true cause, which is, that the Athenians have thought fit to condemn me, and accordingly I have thought it better and more right to remain here and undergo my sentence?"

The modern psychologist would not think so lightly of the physiological explanation; he recognizes in it one of the worthiest goals of scientific endeavor. But he would still maintain that the psychological interpretation of conduct has its proper place. The distinction is not properly that between mechanism and teleology; for a motive, to the psychologist, is a cause among causes. The difference is essentially one of minuteness; physiology being the more minute in its analysis of cause and effect. It is related to psychology much as microscopic is related to gross anatomy. Now the invention of the microscope has not made the sight of the naked eye valueless, even for scientific purposes. Microscopic anatomy has not supplanted gross anatomy but has simply been added to it. In much the same way, the conception of the geological ages is not made trivial by reflecting that the actual succession was one of seconds and not of ages. Detailed maps of every quadrangle in the country do not enable us to dispense with a condensed map of the whole country. The relations which are visible in the condensed map can not be grasped from the detailed maps. The relations brought out by geology would be lost sight of in following second by second, if that were possible, the physical and chemical history of the earth. In a word, the relations that appear in the gross disappear, give place to others, on a minuter view. A detailed view must always be a limited view, for no greater

assemblage of facts can be grasped in one act of comprehension when the facts are minute than when they are broad and inclusive. And as time and space are apparently divisible without limit, as to omniscience "a thousand years are as a day and a day as a thousand years," neither the broad nor the minute view can boast itself against the other. Examine every tissue of the body under the microscope, take cognizance of every cell, its form and relations; and you still know nothing of the facts taught by gross anatomy. Trace out each reaction of an animal, noting every transformation and transmission of energy from the point of stimulation to the point of response, and you still know nothing of animal behavior.

Quite akin to the science of behavior, psychology seeks to trace the relations of those rather gross fragments of the universal process which we call contents of consciousness and mental activities. Its dissection is less minute than that of physiology, but the relations which it reveals are none the less real, and may be none the less illuminating. Motives, conduct, training, efficiency, stages in the development and dissolution of the mind, will still retain their significance however minutely their inner mechanism shall be analyzed by physiology; and the relations between them which psychology discovers and is to discover will always retain both scientific and practical value.



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